Apprenticeship and Industry Training

Natural Gas Compression Technician Apprenticeship Course Outline

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Apprenticeship and Industry Training

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Natural Gas Compression Technician

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Apprenticeship

Apprenticeship is post-secondary education with a difference. Apprenticeship begins with finding an employer. Employers hire apprentices, pay their wages and provide on-the-job training and work experience. Approximately 80 per cent of an apprentice's time is spent on the job under the supervision of a certified journeyperson or qualified tradesperson. The other 20 per cent involves technical training provided at, or through, a post-secondary institution – usually a college or technical institute.

To become certified journeypersons, apprentices must learn theory and skills, and they must pass examinations. Requirements for certification—including the content and delivery of technical training—are developed and updated by the Alberta Apprenticeship and Industry Training Board on the recommendation of the Natural Gas Compression Technician Provincial Apprenticeship Committee.

The graduate of the Natural Gas Compression Technician apprenticeship program is a certified journeyperson who will be able:

- to install, commission, maintain and repair equipment used to gather store and transmit natural gas.

Apprenticeship and Industry Training System

Industry-Driven

Alberta's apprenticeship and industry training system is an industry-driven system that ensures a highly skilled, internationally competitive workforce in more than 50 designated trades and occupations. This workforce supports the economic progress of Alberta and its competitive role in the global market. Industry (employers and employees) establishes training and certification standards and provides direction to the system through an industry committee network and the Alberta Apprenticeship and Industry Training Board. The Alberta government provides the legislative framework and administrative support for the apprenticeship and industry training system.

Alberta Apprenticeship and Industry Training Board

The Alberta Apprenticeship and Industry Training Board provides a leadership role in developing Alberta's highly skilled and trained workforce. The Board's primary responsibility is to establish the standards and requirements for training and certification in programs under the Apprenticeship and Industry Training Act. The Board also provides advice to the Minister of Advanced Education on the needs of Alberta's labour market for skilled and trained workers, and the designation of trades and occupations.

The thirteen-member Board consists of a chair, eight members representing trades and four members representing other industries. There are equal numbers of employer and employee representatives.

Industry Committee Network

Alberta's apprenticeship and industry training system relies on a network of industry committees, including local and provincial apprenticeship committees in the designated trades, and occupational committees in the designated occupations. The network also includes other committees such as provisional committees that are established before the designation of a new trade or occupation comes into effect. All trade committees are composed of equal numbers of employer and employee representatives. The industry committee network is the foundation of Alberta's apprenticeship and industry training system.

Local Apprenticeship Committees (LAC)

Wherever there is activity in a trade, the Board can set up a local apprenticeship committee. The Board appoints equal numbers of employee and employer representatives for terms of up to three years. The committee appoints a member as presiding officer. Local apprenticeship committees:

- monitor apprenticeship programs and the progress of apprentices in their trade, at the local level
- make recommendations to their trade's provincial apprenticeship committee (PAC) about apprenticeship and certification in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- make recommendations to the Board about the appointment of members to their trade's PAC
- help settle certain kinds of disagreements between apprentices and their employers
- carry out functions assigned by their trade's PAC or the Board

Provincial Apprenticeship Committees (PAC)

The Board establishes a provincial apprenticeship committee for each trade. It appoints an equal number of employer and employee representatives, and, on the PAC's recommendation, a presiding officer - each for a maximum of two terms of up to three years. Most PACs have nine members but can have as many as twenty-one. Provincial apprenticeship committees:

- make recommendations to the Board about:
    - standards and requirements for training and certification in their trade
    - courses and examinations in their trade
    - apprenticeship and certification
    - designation of trades and occupations
    - regulations and orders under the Apprenticeship and Industry Training Act
- monitor the activities of local apprenticeship committees in their trade
- determine whether training of various kinds is equivalent to training provided in an apprenticeship program in their trade
- promote apprenticeship programs and training and the pursuit of careers in their trade
- consult with other committees under the Apprenticeship and Industry Training Act about apprenticeship programs, training and certification and facilitate cooperation between different trades and occupations
- consult with organizations, associations and people who have an interest in their trade and with employers and employees in their trade
- may participate in resolving certain disagreements between employers and employees
- carry out functions assigned by the Board

Natural Gas Compression Technician PAC Members at the time of publication.

Mr. R. Hartman	Ponoka	Presiding Officer
Mr. M. Blain	Bonnyville	Employer
Mr. P. Huebler	Airdrie	Employer
Mr. W. Long	Stettler	Employer
Mr J. Graf	Lloydminster	Employer
Mr. K. Kells	Red Deer	Employee
Mr. C. Collicutt	Red Deer	Employee
Mr. E. Schulmeister	Calgary	Employee
Mr. D. Neumann	Barrhead	Employee

Alberta Government

Alberta Advanced Education works with industry, employer and employee organizations and technical training providers to:

- facilitate industry's development and maintenance of training and certification standards
- provide registration and counselling services to apprentices and employers
- coordinate technical training in collaboration with training providers
- certify apprentices and others who meet industry standards

Technical Institutes and Colleges

The technical institutes and colleges are key participants in Alberta's apprenticeship and industry training system. They work with the Board, industry committees and Alberta Advanced Education to enhance access and responsiveness to industry needs through the delivery of the technical training component of apprenticeship programs. They develop lesson plans from the course outlines established by industry and provide technical training to apprentices.

Apprenticeship Safety

Safe working procedures and conditions, incident/injury prevention, and the preservation of health are of primary importance in apprenticeship programs in Alberta. These responsibilities are shared and require the joint efforts of government, employers, employees, apprentices and the public. Therefore, it is imperative that all parties are aware of circumstances that may lead to injury or harm.

Safe learning experiences and healthy environments can be created by controlling the variables and behaviours that may contribute to or cause an incident or injury. By practicing a safe and healthy attitude, everyone can enjoy the benefit of an incident and injury free environment.

Alberta Apprenticeship and Industry Training Board Safety Policy

The Alberta Apprenticeship and Industry Training Board (board) fully supports safe learning and working environments and emphasizes the importance of safety awareness and education throughout apprenticeship training- in both on-the- job training and technical training. The board also recognizes that safety awareness and education begins on the first day of on-the-job training and thereby is the initial and ongoing responsibility of the employer and the apprentice as required under workplace health and safety training. However the board encourages that safe workplace behaviour is modeled not only during on-the-job training but also during all aspects of technical training, in particular, shop or lab instruction. Therefore the board recognizes that safety awareness and training in apprenticeship technical training reinforces, but does not replace, employer safety training that is required under workplace health and safety legislation.

The board has established a policy with respect to safety awareness and training:

> **The board promotes and supports safe workplaces, which embody a culture of safety for all apprentices, employers and employees. Employer required safety training is the responsibility of the employer and the apprentice, as required under legislation other than the *Apprenticeship and Industry Training Act.***

The board's complete document on its 'Apprenticeship Safety Training Policy' is available at www.tradesecrets.alberta.ca; access the website and conduct a search for 'safety training policy'.

Implementation of the policy includes three common safety learning outcomes and objectives for all trade course outlines. These common learning outcomes ensure that each course outline utilizes common language consistent with workplace health and safety terminology. Under the title of 'Standard Workplace Safety', this first section of each trade course outline enables the delivery of generic safety training; technical training providers will provide trade specific examples related to the content delivery of course outline safety training.

Addendum
As immediate implementation of the board's safety policy includes common safety learning outcomes and objectives for all course outlines, this trade's PAC will be inserting these safety outcomes into the main body of their course outline at a later date. In the meantime the addendum below immediately places the safety outcomes and their objectives into this course outline thereby enabling technical training providers to deliver the content of these safety outcomes.

STANDARD WORKPLACE SAFETY

A. Safety Legislation, Regulations & Industry Policy in the Trades

Outcome: ***Describe legislation, regulations and practices intended to ensure a safe work place in this trade.***

1. Demonstrate the ability to apply the Occupational Health and Safety Act, Regulation and Code.
2. Explain the role of the employer and employee in regard to Occupational Health and Safety (OH&S) regulations, Worksite Hazardous Materials Information Systems (WHMIS), fire regulations, Workers Compensation Board regulations, and related advisory bodies and agencies.
3. Explain industry practices for hazard assessment and control procedures.
4. Describe the responsibilities of workers and employers to apply emergency procedures.
5. Describe positive tradesperson attitudes with respect to housekeeping, personal protective equipment and emergency procedures.
6. Describe the roles and responsibilities of employers and employees with respect to the selection and use of personal protective equipment (PPE).
7. Select, use and maintain appropriate PPE for worksite applications.

B. Climbing, Lifting, Rigging and Hoisting

Outcome: ***Describe the use of personal protective equipment (PPE) and safe practices for climbing, lifting, rigging and hoisting in this trade.***

1. Select, use and maintain specialized PPE for climbing, lifting and load moving equipment.
2. Describe manual lifting procedures using correct body mechanics.
3. Describe rigging hardware and the safety factor associated with each item.
4. Select the correct equipment for rigging typical loads.
5. Describe hoisting and load moving procedures.

C. Hazardous Materials & Fire Protection

Outcome: ***Describe the safety practices for hazardous materials and fire protection in this trade.***

1. Describe the roles, responsibilities features and practices related to the workplace hazardous materials information system (WHMIS) program.
2. Describe the three key elements of WHMIS.
3. Describe handling, storing and transporting procedures when dealing with hazardous material.
4. Describe safe venting procedures when working with hazardous materials.
5. Describe fire hazards, classes, procedures and equipment related to fire protection.

Workplace Health and Safety

A tradesperson is often exposed to more hazards than any other person in the work force and therefore should be familiar with and apply the Occupational Health and Safety Act, Regulations and Code when dealing with personal safety and the special safety rules that apply to all daily tasks.

Workplace Health and Safety (Alberta Employment, Immigration and Industry) conducts periodic inspections of workplaces to ensure that safety regulations for industry are being observed.

Additional information is available at www.worksafely.org

Technical Training

Apprenticeship technical training is delivered by the technical institutes and many colleges in the public post-secondary system throughout Alberta. The colleges and institutes are committed to delivering the technical training component of Alberta apprenticeship programs in a safe, efficient and effective manner. All training providers place great emphasis on safe technical practices that complement safe workplace practices and help to develop a skilled, safe workforce.
The following technical training providers deliver Natural Gas Compression Technician apprenticeship training:

Southern Alberta Institute of Technology

Procedures for Recommending Revisions to the Course Outline

Advanced Education has prepared this course outline in partnership with the Natural Gas Compression Technician Provincial Apprenticeship Committee.

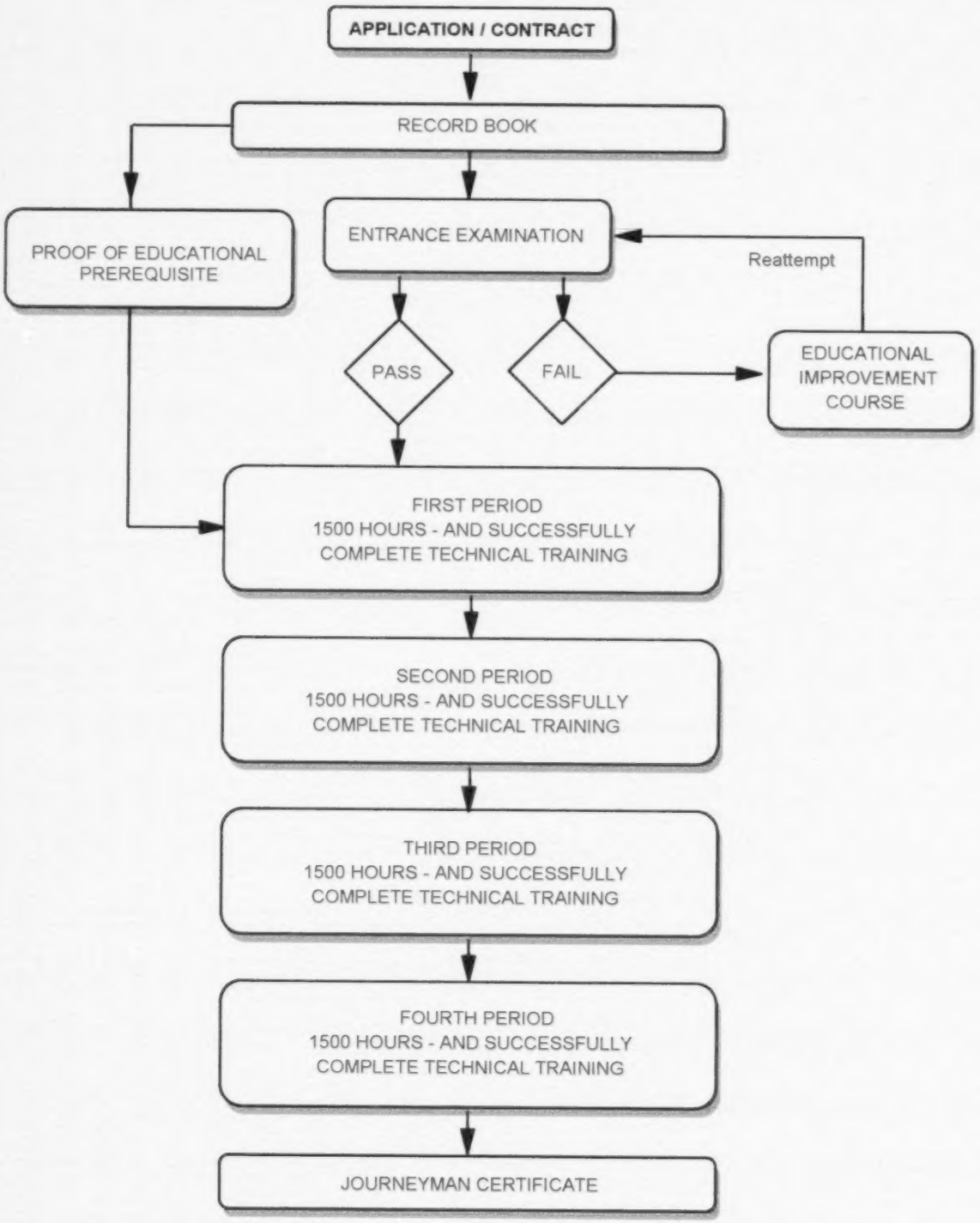
This course outline was approved on June 17, 2011 by the Alberta Apprenticeship and Industry Training Board on a recommendation from the Provincial Apprenticeship Committee. The valuable input provided by representatives of industry and the institutions that provide the technical training is acknowledged.

Any concerned individual or group in the province of Alberta may make recommendations for change by writing to:

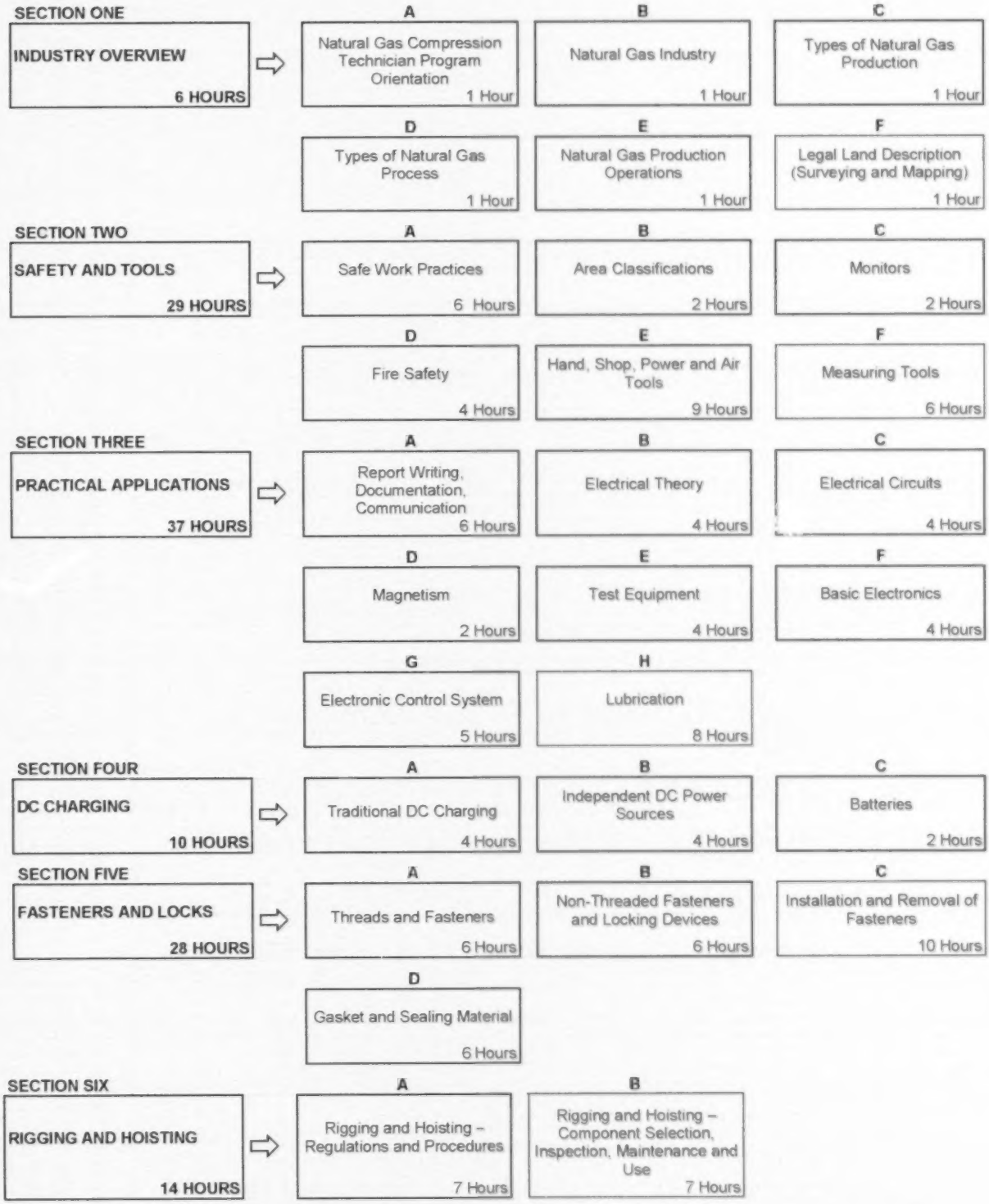
Natural Gas Compression Technician Provincial Apprenticeship Committee
c/o Industry Programs and Standards
Apprenticeship and Industry Training
Advanced Education
10th floor, Commerce Place
10155 102 Street NW
Edmonton AB T5J 4L5

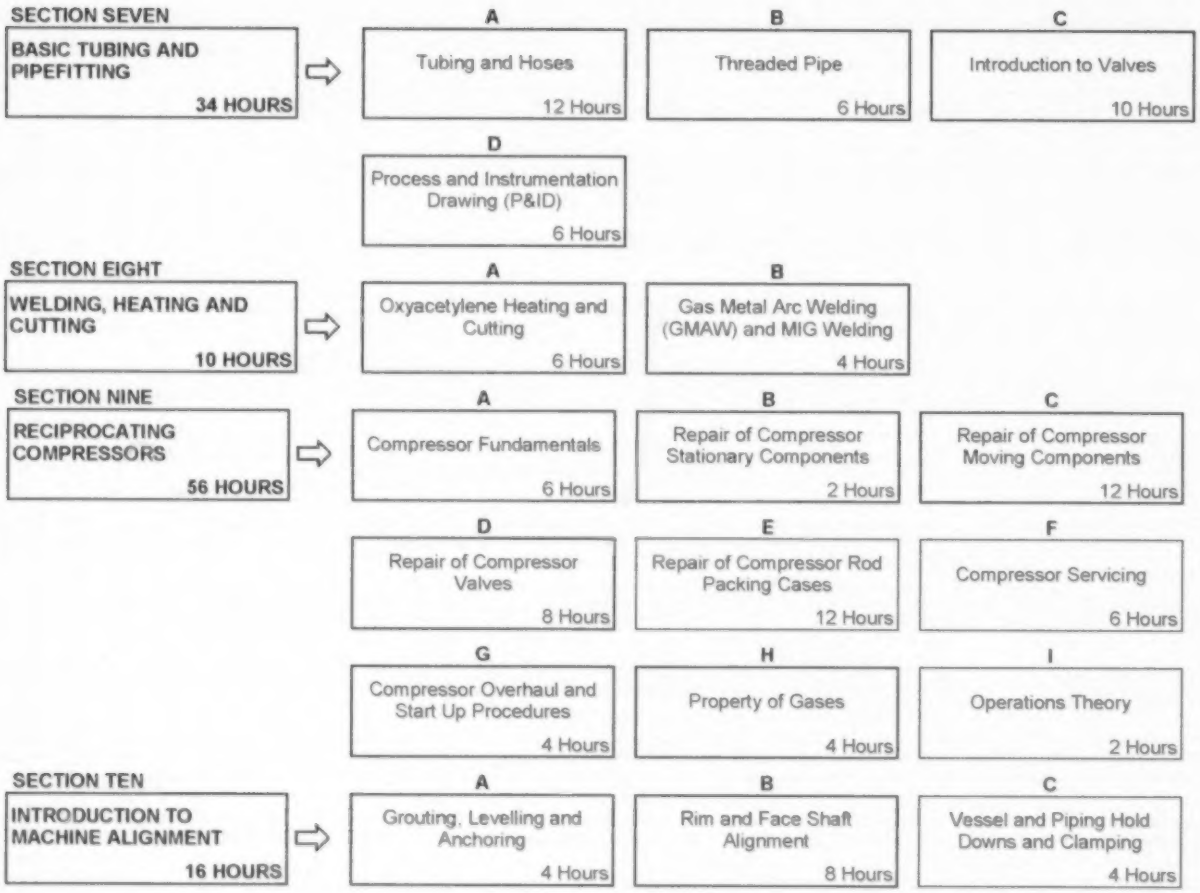
It is requested that recommendations for change refer to specific areas and state references used. Recommendations for change will be placed on the agenda for regular meetings of the Natural Gas Compression Technician Provincial Apprenticeship Committee.

Apprenticeship Route toward Certification



Natural Gas Compression Technician Training Profile
First Period
(8 Weeks – 30 Hours–Total of 240 Hours)




SECTION SEVEN
BASIC TUBING AND PIPEFITTING
34 HOURS
A
Tubing and Hoses
12 Hours
B
Threaded Pipe
6 Hours
C
Introduction to Valves
10 Hours
D
Process and Instrumentation Drawing (P&ID)
6 Hours
SECTION EIGHT
WELDING, HEATING AND CUTTING
10 HOURS
A
Oxyacetylene Heating and Cutting
6 Hours
B
Gas Metal Arc Welding (GMAW) and MIG Welding
4 Hours
SECTION NINE
RECIPROCATING COMPRESSORS
56 HOURS
A
Compressor Fundamentals
6 Hours
B
Repair of Compressor Stationary Components
2 Hours
C
Repair of Compressor Moving Components
12 Hours
D
Repair of Compressor Valves
8 Hours
E
Repair of Compressor Rod Packing Cases
12 Hours
F
Compressor Servicing
6 Hours
G
Compressor Overhaul and Start Up Procedures
4 Hours
H
Property of Gases
4 Hours
I
Operations Theory
2 Hours
SECTION TEN
INTRODUCTION TO MACHINE ALIGNMENT
16 HOURS
A
Grouting, Levelling and Anchoring
4 Hours
B
Rim and Face Shaft Alignment
8 Hours
C
Vessel and Piping Hold Downs and Clamping
4 Hours

Second Period
(8 Weeks – 30 Hours–Total of 240 Hours)

SECTION ONE

NATURAL GAS FUELED ENGINES
112 HOURS

A	B	C
Engine Fundamentals 12 Hours	Engine System and Servicing 22 Hours	Engine Installation and Start Up 6 Hours

D	E	F
Engine Block and Cylinder Liner Fundamentals 4 Hours	Engine Block and Cylinder Liner Service 8 Hours	Piston, Piston Rings and Connecting Rod Fundamentals 4 Hours

G	H	I
Piston, Piston Rings and Connecting Rod Service 8 Hours	Crankshaft, Bearings and Related Component Fundamentals 12 Hours	Crankshaft, Bearing and Related Component Service 14 Hours

J	K	L
Camshaft and Follower Fundamentals 4 Hours	Camshaft and Follower Service 4 Hours	Cylinder Head Fundamentals 6 Hours

M
Cylinder Head Service 8 Hours

SECTION TWO

LUBRICATION AND CRANKCASE VENTILATION
14 HOURS

A	B	C
Engine Lubrication 8 Hours	Oil Analysis Interpretation and Diagnosis 4 Hours	Crankcase Fume Control and Extraction 2 Hours

SECTION THREE

AIR INDUCTION AND EXHAUST SYSTEMS
3 HOURS

A
Air Induction and Exhaust Systems 3 Hours

SECTION FOUR

IGNITION SYSTEMS
20 HOURS

A	B	C
Ignition System Fundamentals 4 Hours	Magneto Ignition Systems 4 Hours	Digital Ignition Systems 4 Hours

D
Ignition System Diagnosis and Service 8 Hours

SECTION FIVE

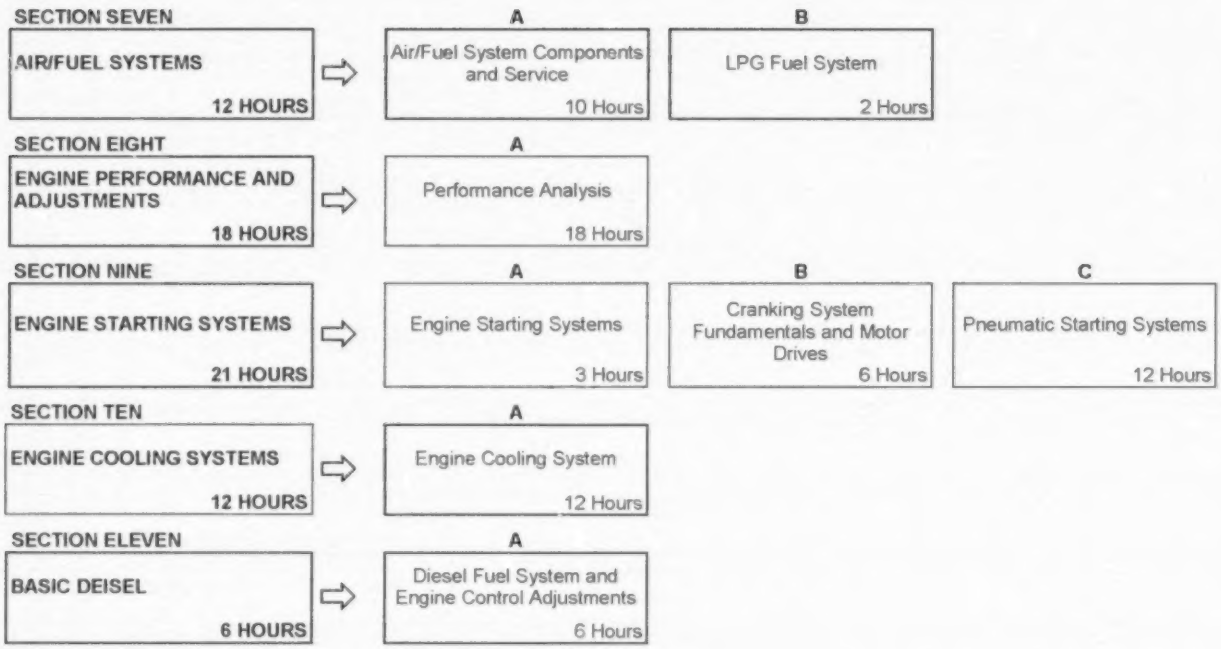
GOVERNOR SYSTEMS
10 HOURS

A
Governors 10 Hours

SECTION SIX

COMBUSTION THEORY
12 HOURS

A	B
Fuel Properties 4 Hours	Combustion Process 8 Hours


SECTION SEVEN
AIR/FUEL SYSTEMS
12 HOURS
A
Air/Fuel System Components and Service
10 Hours
B
LPG Fuel System
2 Hours
SECTION EIGHT
ENGINE PERFORMANCE AND ADJUSTMENTS
18 HOURS
A
Performance Analysis
18 Hours
SECTION NINE
ENGINE STARTING SYSTEMS
21 HOURS
A
Engine Starting Systems
3 Hours
B
Cranking System Fundamentals and Motor Drives
6 Hours
C
Pneumatic Starting Systems
12 Hours
SECTION TEN
ENGINE COOLING SYSTEMS
12 HOURS
A
Engine Cooling System
12 Hours
SECTION ELEVEN
BASIC DEISEL
6 HOURS
A
Diesel Fuel System and Engine Control Adjustments
6 Hours

Third Period
(8 Weeks – 30 Hours–Total of 240 Hours)

SECTION ONE

ROTARY COMPRESSORS
48 HOURS

- **A** — Screw Compressors — 24 Hours
- **B** — Vane Compression — 12 Hours
- **C** — Scroll Compressors — 3 Hours
- **D** — Dynamic Compressors — 6 Hours
- **E** — Lobe Blower — 3 Hours

SECTION TWO

PUMPS
30 HOURS

- **A** — Pump Selection — 6 Hours
- **B** — Dynamic Pumps — 6 Hours
- **C** — Positive Displacement Pumps — 6 Hours
- **D** — Pump Operation and Repair — 12 Hours

SECTION THREE

AC MOTORS AND DRIVES
4 HOURS

- **A** — AC Motors — 2 Hours
- **B** — Starters and Drives — 2 Hours

SECTION FOUR

POWER GENERATION
26 HOURS

- **A** — AC Power Generation — 26 Hours

SECTION FIVE

POWER TRANSMISSION
64 HOURS

- **A** — Transmission of Force and Motion — 4 Hours
- **B** — Bearing and Seals — 16 Hours
- **C** — Couplings — 12 Hours
- **D** — Belts — 6 Hours
- **E** — Gearing Fundamentals — 12 Hours
- **F** — Shaft Drives — 2 Hours
- **G** — Chain Drives — 3 Hours
- **H** — Hydraulic Drives — 3 Hours
- **I** — Clutch Fundamentals and Service — 6 Hours

SECTION SIX

EQUIPMENT ALIGNMENT
22 HOURS

- **A** — Cross Dial Alignment — 12 Hours
- **B** — Laser Shaft Alignment — 6 Hours
- **C** — Machine Levelling — 4 Hours

SECTION SEVEN

VIBRATION
30 HOURS

- **A** — Vibration Analysis — 14 Hours
- **B** — Vibration Measurement — 12 Hours
- **C** — Balancing — 4 Hours

SECTION EIGHT

PREDICTIVE AND FAILURE ANALYSIS
16 HOURS

- **A** — Non-Destructive Testing — 6 Hours
- **B** — Failure Analysis — 10 Hours

Fourth Period
(8 Weeks – 30 Hours–Total of 240 Hours)

SECTION ONE

HEAT EXCHANGERS
18 HOURS

A	B	C
Heat Exchangers 8 Hours	Fans 8 Hours	Sound 2 Hours

SECTION TWO

PROCESS EQUIPMENT I
85 HOURS

A	B	C
Gas Compression 26 Hours	Separation and Filtration 4 Hours	Gas and Air Dryers 16 Hours

D	E	F
Process Dehydration 5 Hours	Fractionation 3 Hours	Boilers and Direct Fired Heaters 2 Hours

G	H	I
Fire and Gas Detection 6 Hours	Emergency Shutdown Systems 3 Hours	Pressure Safety Relieving Devices 4 Hours

J
Pressure Regulators 16 Hours

SECTION THREE

PROCESS EQUIPMENT II
54 HOURS

A	B	C
Pneumatic Systems 6 Hours	Natural Gas Process Refrigeration 12 Hours	Gas Turbines 6 Hours

D
Natural Gas Facility Control Philosophy 30 Hours

SECTION FOUR

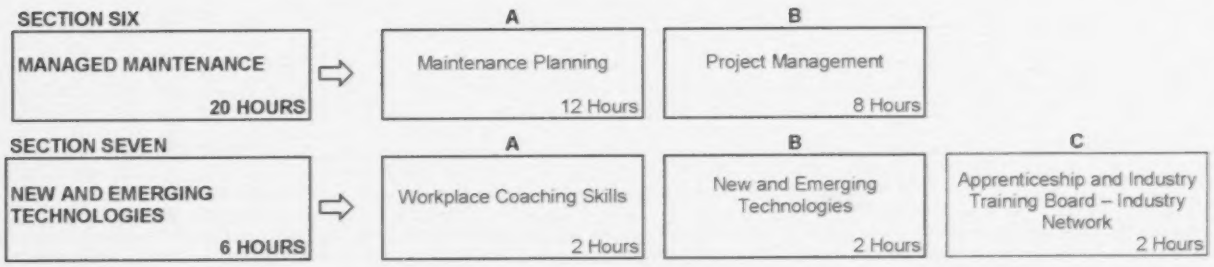
PNUEMATIC CONTROLS
31 HOURS

A	B	C
Pressure Measurement 10 Hours	Link and Lever Systems 6 Hours	Pneumatic Components and Feedback Systems 15 Hours

SECTION FIVE

ELECTRONIC CONTROL - PROGRAM LOGIC CONTROL
26 HOURS

A	B
Controls: Schematics, Ladder Diagrams and Logic Control 20 Hours	Protocols 6 Hours


SECTION SIX
MANAGED MAINTENANCE
20 HOURS
A
Maintenance Planning
12 Hours
B
Project Management
8 Hours
SECTION SEVEN
NEW AND EMERGING TECHNOLOGIES
6 HOURS
A
Workplace Coaching Skills
2 Hours
B
New and Emerging Technologies
2 Hours
C
Apprenticeship and Industry Training Board – Industry Network
2 Hours

FIRST PERIOD TECHNICAL TRAINING
NATURAL GAS COMPRESSION TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE:..... INDUSTRY OVERVIEW ..... 6 HOURS

A. Natural Gas Compression Technician Program Orientation ..... 1 Hour

Outcome: ***Explain the role of apprentices, journeypersons, provincial apprenticeship committee and Alberta Apprenticeship and Industry Training in the development and maintenance of the Natural Gas Compression Technician trade in Alberta.***

1. Describe the apprenticeship training system in Alberta.
2. Describe how to locate NGCT information on http://tradesecrets.alberta.ca
3. Describe the responsibilities for the Contract of Apprenticeship by the apprentice, employer and Alberta Apprenticeship and Industry Training.
4. Describe the NGCT course outline, learning outcomes and objectives.
5. Describe the contents of the apprenticeship training record book and its importance.

B. Natural Gas Industry ..... 1 Hour

Outcome: ***Explain the natural gas industry in western Canada.***

1. Describe the natural gas industry.
2. Define upstream, midstream and downstream functions of the natural gas industry.
3. Describe the industry associations involved in natural gas (CAPP, SEPAC, CEPA, GPA).
4. Describe the natural gas compression industry subsectors. (producers, fabricators, manufacturers, service providers)
5. Define Liquid Natural Gas (LNG) and Compressed Natural Gas (CNG).

C. Types of Natural Gas Production..... 1 Hour

Outcome: ***Explain natural gas production types in western Canada.***

1. Describe natural gas and natural gas bi-products.
2. Describe typical source producing types.
3. Describe in general terms the exploration of natural gas.

D. Types of Natural Gas Process..... 1 Hour

Outcome: ***Describe the general processes in the production and delivery of natural gas and natural gas bi-products.***

1. Describe typical upstream production equipment and processes.
2. Describe typical midstream production equipment and processes.
3. Describe typical downstream processes.
4. Describe Liquefied Natural Gas (LNG) equipment and production processes.

E. Natural Gas Production Operations ..... 1 Hour

Outcome: ***Describe typical roles and functions that comprise the natural gas industry.***

1. Describe typical worker roles found in exploration, drilling and completions, facilities and pipeline construction, operations and maintenance.
2. Describe roles of regulatory boards and institutions.
3. Describe typical producer land lease and rights processes.
4. Describe gas marketing and accounting.

F. Legal Land Description (Surveying and Mapping) ..... 1 Hour

Outcome: ***Describe and demonstrate site location using current industry methods.***

1. Describe ranges, townships, sections, quarters and legal subdivisions.
2. Describe the Alberta Township Survey (ATS) system.
3. Describe the Global Positioning System (GPS).

SECTION TWO ..... SAFETY AND TOOLS ..... 29 HOURS

A. Safe Work Practices ..... 6 Hours

Outcome: ***Describe safe work practices and environmental protection.***

1. Explain responsibilities of the employee, employer and government.
2. Describe general safety and accident prevention.
3. Apply the requirements of WHMIS to the worksite.
4. Describe personal protective equipment and practices used in industrial applications.
5. Explain breathing safeguards.
6. Explain safety requirements for working at heights.
7. Describe the use of various types of ladders.
8. Explain task hazard identification.
9. Explain hot and cold safe work permits.

B. Area Classifications ..... 2 Hours

Outcome: ***Describe the classification of hazardous locations and general rules that apply to those locations.***

1. Define the specific terms from Section 18 of the Canadian Electrical Code Part 1 that apply to area classifications.
2. Apply the general rules regarding installation and maintenance in hazardous locations.

C. Monitors ..... 2 Hours

Outcome: ***Perform and document a bump test for calibration of a personal gas monitor.***

1. Describe general function and use of personal monitors.
2. Explain monitor testing and calibration procedures.
3. Identify occupational limits and standards.

D. Fire Safety ..... 4 Hours

Outcome: ***Identify and describe fire classes, extinguishers, prevention and detection.***

1. Describe the classes of fires and the appropriate fire extinguishers suitable to fight each of these fires.
2. Describe the procedures and equipment related to preventing, detecting and warning of fires.

E. Hand, Shop, Power and Air Tools ..... 9 Hours

Outcome: ***Demonstrate the correct use of hand, shop, air and power tools common to the trade.***

1. Describe the types, uses and care of hand tools.
2. Describe the procedures required to safely operate various types and capacities of shop puller and pressing equipment.
3. Describe and use cutting hand tools common to the trade.
4. Demonstrate proper care and safe use of common power, pneumatic and hydraulic hand tools.
5. Describe the safe use of tools in hazardous locations.

F. Measuring Tools ..... 6 Hours

Outcome: ***Demonstrate the correct use of measuring tools common to the trade.***

1. Perform calculations related to measurement using imperial and metric units.
2. Perform linear measurements using basic measuring tools.
3. Perform linear measurements using precision measuring tools.
4. Perform accurate torque measurements using torque tools.

SECTION THREE ..... PRACTICAL APPLICATIONS ..... 37 HOURS

A. Report Writing, Documentation, Communication ..... 6 Hours

Outcome: ***Communicate with clients, staff and related trades people using industry standard terms, forms and documents.***

1. Name standard terms and units of measure for components and operations.
2. Effectively communicate trade related information with clients and other trades.
3. Capture and record concern, cause and correction detail.
4. Capture and record diagnostic adjustment measurement values.
5. Document and record client concerns, diagnosis and assessments undertaken.
6. Capture legal and safety documentation.
7. Record requirements of hazard identification.
8. Record monitoring values and measurements of equipment.
9. Complete necessary documents and forms for inventory and billing purposes.

B. Electrical Theory ..... **4 Hours**

Outcome: ***Apply scientific principles to explain electrical theory.***

1. Explain the physical properties of conductors, semiconductors and insulators.
2. Explain electricity in terms of voltage, current and resistance.
3. Explain direct current, alternating current and static electricity.

C. Electrical Circuits ..... **4 Hours**

Outcome: ***Identify electrical circuit types and circuit defects.***

1. List the components of a basic electrical circuit.
2. Explain the effects of circuit defects on circuit operation.
3. Identify three circuit types and their properties.
4. Explain electrical laws and formulas to mathematically calculate circuit values.

D. Magnetism ..... **2 Hours**

Outcome: ***Apply scientific principles to explain the theory of magnetism.***

1. Explain the fundamental laws of magnetism.
2. Explain the properties and applications of permanent magnets.
3. Explain the construction, operation and applications of electromagnets.
4. Explain the principles of electromagnetic induction.

E. Test Equipment ..... **4 Hours**

Outcome: ***Use electrical test equipment to measure electrical values and check circuit operation.***

1. Explain the construction and operation of voltmeters, ammeters and ohmmeters.
2. Explain meter precautions when measuring voltage, current and resistance.
3. Measure voltage at various points on a circuit and interpret results.
4. Measure current flow on various points on a circuit and interpret the results.
5. Measure resistance using an ohmmeter.

F. Basic Electronics ..... **4 Hours**

Outcome: ***Test discrete electronic components used in the trade.***

1. Compare and contrast solid state electronic and electrical circuitry.
2. Explain the properties, applications, and test procedures for resistors.
3. Explain the properties, applications and test procedures for diodes.
4. Identify the conditions that affect the life of electronic devices.

G. Electronic Control System ..... 5 Hours

Outcome: ***Describe the operation of basic computer controlled systems.***

1. Identify the terminology commonly used with computer controls and components.
2. Explain the function of electronic control system components.
3. Explain interaction between inputs, processors and outputs to control a circuit or a system.
4. Identify electronic test equipment used for diagnosis of electronic systems.

H. Lubrication ..... 8 Hours

Outcome: ***Service, repair and diagnose problems related to lubricating systems and their associated components.***

1. Identify and describe the common functions and characteristics of lubricating oils.
2. Explain the principles of operation of common types of lubrication systems and their related components.
3. Explain the grades and types of lubricating oils.
4. Demonstrate correct procedures to follow when disposing of lubricants and filters.
5. Describe the use of oil analysis as a diagnostic tool.

SECTION FOUR ..... DC CHARGING ..... 10 HOURS

A. Traditional DC Charging Systems ..... 4 Hours

Outcome: ***Explain the design, operation and service of DC charging systems.***

1. Explain the purpose of the charging system in relation to equipment operation.
2. Identify DC charging system components.
3. Describe the operational characteristics of an alternator.
4. Describe the operational characteristics of a voltage regulator.
5. Test and service DC charging systems.

B. Independent DC Power Source ..... 4 Hours

Outcome: ***Explain the design, operation and service of independent DC power sources.***

1. Describe independent DC power sources
2. Identify independent DC power source components.
3. Test and service independent DC power sources.

C. Batteries ..... 2 Hours

Outcome: ***Explain the design, operation and service of DC batteries.***

1. Describe battery construction.
2. Explain sizing and capacity with regards to applications.
3. Perform battery maintenance and testing.
4. Explain multiple battery circuits in relation to connections and battery compatibility.
5. List safety precautions and procedures for storing, boosting and charging batteries.

SECTION FIVE ..... FASTENERS AND LOCKS ..... 28 HOURS

A. Threads and Fasteners ..... 6 Hours

Outcome: ***Identify materials and fasteners commonly used in the trade.***

1. Identify common metallic materials and their applications.
2. Identify types of threaded fasteners and their applications
3. Identify types of non-threaded fasteners and their applications.

B. Non-threaded Fasteners and Locking Devices ..... 6 Hours

Outcome: ***Explain non-threaded fasteners and locking devices.***

1. Identify the types and purposes of non-threaded fasteners.
2. Explain the types and applications of locking devices.
3. Explain the use of thread sealing and locking compounds.
4. Explain the use of lock wire.

C. Installation and Removal of Fasteners ..... 10 Hours

Outcome: ***Explain the installation and removal of fasteners.***

1. Describe methods of removing broken fasteners and tools and thread reconditioning.
2. Explain the theory of tensioning.
3. Describe methods of tensioning.
4. Explain torque and preload procedures and precautions required when securing fastening devices.

D. Gasket and Sealing Material ..... 6 Hours

Outcome: ***Describe the installation and maintenance of gaskets used in industrial machinery.***

1. Describe the safety rules and precautions applicable to the installation, removal and replacements of gaskets.
2. Describe the types of gasket joints common in industry.
3. List the types and applications of various kinds of gasket material.
4. Describe joint disassembly and gasket removal techniques.

SECTION SIX ..... RIGGING AND HOISTING ..... 14 HOURS

A. Rigging and Hoisting – Regulations and Procedures ..... 7 Hours

Outcome: ***Explain rigging and hoisting regulations and procedures.***

1. Describe OH&S regulations pertaining to rigging and hoisting practices and equipment standards.
2. Discuss *Safe Working Load* implementation in everyday hoisting and rigging.
3. Communicate using hand signals to direct hoist and lift operations.

B. Rigging and Hoisting Components Selection, Inspection, Maintenance and Use .....7 Hours

Outcome: ***Describe selection, inspection maintenance, and use of lifting components.***

1. Describe selection, inspection, maintenance and use of wire rope.
2. Describe selection, inspection, maintenance and use of lifting chain.
3. Describe selection, inspection, maintenance and use of synthetic webbing slings.
4. Describe selection, inspection, maintenance and use of rings, links, hooks, swivels, eyebolts, shackles, wire rope clips, blocks and sheaves.
5. Describe use of electric overhead traveling cranes and mobile shop cranes.

SECTION SEVEN.....BASIC TUBING AND PIPE FITTING..... 34 HOURS

A. Tubing and Hoses.....12 Hours

Outcome: ***Perform tube jointing and tube bending procedures.***

1. Identify the different types, sizes and fittings for tube applications.
2. Identify common tools and techniques used in tube joining and bending.
3. Identify hazards associated with tube and fitting selection and installation.
4. Calculate tube bending lengths for various tube configurations and angles.
5. Demonstrate tube bending for instrument installations.
6. Design and install raceway to support tubing.
7. Install tubing and tube fittings for safe leak proof installations.
8. Demonstrate the use of common tools used in jointing tube.
9. Identify the different types, sizes and fittings for hose applications.
10. Demonstrate assembly/disassembly of hose fittings.

B. Threaded Pipe.....6 Hours

Outcome: ***Perform threading techniques complete and test the piping project to specific requirements.***

1. Identify tools used for threading pipe.
2. Use hand and power tools to thread pipe.
3. Demonstrate use of drophead dies, jam-proof ratchet threaders and power threaders.
4. Prepare a threaded pipe spool to required dimensions.

C. Introduction of Valves.....10 Hours

Outcome: ***Describe the type, application and maintenance of valves.***

1. Describe valve types, construction and operation of various valves.
2. Describe valve, repair, overhaul, maintenance and test procedures.

D. Process and Instrumentation Drawing..... 6 Hours

Outcome: ***Interpret Process and Instrumentation Drawing (P&ID)***

1. Identify symbols used.
2. Identify flow and functions.
3. Identify reference materials and components.

SECTION EIGHT.....WELDING HEATING AND CUTTING.....10 HOURS

A. Oxyacetylene Heating and Cutting ..... 6 Hours

Outcome: ***Perform metal heating and cutting operations safely using oxyacetylene equipment.***

1. Demonstrate the use of personal protective equipment.
2. Describe the characteristics and handling procedures for oxygen and acetylene.
3. Demonstrate handling procedures for regulators and hoses.
4. Demonstrate the use, care and maintenance of torches and tips.
5. Perform basic cutting operations.

B. Gas Metal Arc Welding (GMAW) MIG Welding..... 4 Hours

Outcome: ***Perform non-structural welding using GMAW (MIG) welding equipment.***

1. Describe the principles of operation of GMAW.
2. Identify the components of a basic GMAW set up.
3. Diagnose and demonstrate corrective measures for malfunctioning GMAW equipment.
4. Identify the precautions you must take against electrical shock, toxic fumes and radiant energy associated with GMAW.

SECTION NINE.....RECIPROCATING COMPRESSORS.....56 HOURS

A. Compressor Fundamentals ..... 6 Hours

Outcome: ***Describe the fundamentals of compressors.***

1. Explain gas theory and gas law.
2. Describe compressor applications.
3. Describe compressor classification methods.
4. Identify reciprocating compressor components.
5. Explain the basic compressor system.
6. Describe basic compressor terminology.

B. Repair of Compressor Stationary Components ..... 2 Hours

Outcome: ***Explain the installation and repair of compressor stationary components.***

1. Describe the frame/crankcase and foundation inspection and repair methods.
2. Describe the types, inspection and repair of compressor bearings.
3. Describe the inspection and repair procedures for cylinders.

C. Repair of Compressor Moving Components ..... 12 Hours

Outcome: ***Explain reciprocating compressor moving component inspections and repair.***

1. Describe the inspection and repair of crankshafts.
2. Describe the types, inspection and repair of connecting rods.
3. Describe the installation and repair of crossheads.
4. Describe the function, inspection and reconditioning procedures of pistons and piston rods.

D. Repair of Compressor Valves ..... 8 Hours

Outcome: ***Describe reciprocating compressor valves and gas sealing inspection and repair.***

1. Describe the types, inspection and repair of compressor valves.

E. Repair of Compressor Rod Packing Cases ..... 12 Hours

Outcome: ***Describe reciprocating compressor pistons and rod packing cases inspection and repair.***

1. Describe the types, inspection and repair of piston and rod packing.

F. Compressor Servicing ..... 6 Hours

Outcome: ***Explain reciprocating compressor servicing.***

1. Describe the function and components of internal and frame lubricating systems.
2. Describe the function and components of external frame lubrication systems.
3. Describe the types of air filtration.
4. Describe the types of compressor cooling systems.
5. Describe the various types of failure analysis techniques.

G. Compressor Overhaul and Start Up Procedures ..... 4 Hours

Outcome: ***Explain reciprocating compressor overhaul and start up procedures.***

1. Explain the safety in regards to reciprocating compressors.
2. Explain the importance of manufacturer specifications and manuals.
3. Describe reciprocating compressor dismantling and reassembly procedures.
4. Describe compressor start up procedures.

H. Property of Gases ..... 4 Hours

Outcome: ***Solve Problems related to ideal gases. (Gas Laws and Coefficient of Linear Expansion and Laws of Perfect Gases)***

1. Recognize the principles and application of pressure and temperature as they relate to gas laws.
2. Solve trade related problems involving the Perfect Gas Laws including Boyles Law, Charles Law, Gay-Lussacs Law and the Combined Gas Law.
3. Describe the principles of gas compressibility and volumetric expansion.

I. Operations Theory ..... 2 Hours

Outcome: ***Explain performance operations theory.***

1. Perform basic performance operations.
2. Perform reversal and rod load calculations.
3. Perform set point calculations.
4. Explain temperature and pressure protection.

SECTION TEN.....INTRODUCTION TO MACHINE ALIGNMENT.....16 HOURS

A. Grouting, Levelling and Anchoring ..... 4 Hours

Outcome: ***Describe machine levelling and grouting procedures.***

1. Describe levelling tools, equipment and procedures.
2. Explain the types, purposes and methods of grouting.

B. Rim and Face Shaft Alignment ..... 8 Hours

Outcome: ***Align two machine shafts using the rim and face method.***

1. List the reasons for aligning machine shafts.
2. Describe pre-alignment procedures.
3. Describe machine shaft alignment procedures with regards to the rim and face method of shaft alignment.
4. Determine the alignment corrections necessary to align two machine shafts in the vertical plane, using the rim and face formula method.
5. Determine the alignment corrections necessary to align two machine shafts in the horizontal plane, using the rim and face formula method.

C. Vessel and Piping Hold Downs and Clamping ..... 4 Hours

Outcome: ***Describe vessel and pipe hold downs and their application.***

1. Describe the purpose and application of hold downs.
2. Describe clamping and their reasons for their use.
3. Describe effects of improper adjustment and methods of correction.

SECOND PERIOD TECHNICAL TRAINING
NATURAL GAS COMPRESSION TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE.....NATURAL GAS FUELED ENGINES ..... 112 HOURS

A. Engine Fundamentals ..... 12 Hours

Outcome: ***Explain the working fundamentals of natural gas stationary engines.***

1. Identify the major components of stationary natural gas engines.
2. Explain engine operating principles.
3. Describe natural gas engine classification methods; lean burn, rich burn, pre-chamber combustion, and lean turbulent combustion.

B. Engine Systems and Servicing ..... 22 Hours

Outcome: ***Describe natural gas engine systems functions, operations, service and inspections.***

1. Describe the lubrication systems, function, operation, inspection and service.
2. Describe the crankcase ventilation systems, function, operation, inspection and service.
3. Describe the cooling systems, function, operation, inspection and service.
4. Describe the induction systems, functions, operation, inspection and service.
5. Describe the ignition systems, function, operation, inspection and service.
6. Describe the fuels and fuel systems, function, types, operation, inspection and service.
7. Describe the starting systems, function, operation, types, inspection and service.
8. Outline the methods used in basic tune up, troubleshooting and failure analysis.
9. State the purpose and methods of engine preventative maintenance programs.

C. Engine Installation and Start-Up ..... 6 Hours

Outcome: ***Describe the procedures for installing and starting stationary natural gas engines.***

1. State correct engine installation procedures.
2. Explain engine start up procedures and checks.

D. Engine Block and Cylinder Liner Fundamentals ..... 4 Hours

Outcome: ***Recognize the different designs of cylinder blocks and liners used in engine construction.***

1. State the functions of an engine cylinder block.
2. Identify cylinder block construction and design features.
3. Describe the construction and design features or removable cylinder liners.

E. Engine Block and Cylinder Liner Service ..... 8 Hours

Outcome: ***Inspect an engine block assembly for serviceability. Inspect engine blocks for cracks, thread, bearing bore and machined surface condition.***

1. Inspect engine blocks for cracks, thread, bearing bore and machined surface condition.
2. Explain cylinder block repair procedures for cracks, threads, bearing bores and machined conditions.
3. Explain inspection and reconditioning procedures for a cylinder block with integral cylinders.
4. Perform removable cylinder liner service.

F. Piston, Piston Rings and Connecting Rod Fundamentals ..... 4 Hours

Outcome: ***Describe the functions and design features of pistons, piston rings and connecting rods.***

1. Explain the function, construction and design features of pistons and piston pins.
2. Explain the function, construction and design features of piston rings.
3. Explain the function, construction and design features of connecting rods.
4. Explain piston cooling types and methods.

G. Piston, Piston Rings and Connecting Rod Service ..... 8 Hours

Outcome: ***Service a piston and connecting rod assembly.***

1. Remove and disassemble piston and connecting rod assemblies.
2. Inspect piston and pin for reuse.
3. Explain connecting rod service procedures.
4. Install piston and connecting rod assemblies.

H. Crankshaft, Bearings and Related Component Fundamentals ..... 12 Hours

Outcome: ***Describe the functions and design features of crankshafts and their related components.***

1. Explain the function and design features of crankshafts.
2. Explain methods used to achieve engine balance.
3. State the functions of crankshaft seals, gears and flywheels.
4. Describe the function and design features of friction bearings specific to engines.
5. Explain the lubrication principles of engine friction bearings.

I. Crankshaft, Bearing and Related Component Service ..... 14 Hours

Outcome: ***Service crankshafts, friction bearings and related components.***

1. Remove crankshaft and bearings from an engine block.
2. Inspect and measure crankshafts to determine serviceability.
3. Inspect flywheel and vibration damper to determine serviceability.
4. Identify common crankshaft and bearing failures.
5. Install crankshafts and related components.

J. Camshaft and Follower Fundamentals ..... 4 Hours

Outcome: ***Describe the functions and design features of camshafts and related components.***

1. Explain the function and design features of camshafts, camshaft bearings and seals.
2. Explain the function and design features of camshaft followers.
3. Explain camshaft drive mechanisms and timing.

K. Camshaft and Follower Service ..... 4 Hours

Outcome: ***Service camshafts and related components.***

1. Remove camshaft and related components from an engine block.
2. Inspect and measure camshafts and related components to determine serviceability.
3. Install camshaft and related components.

L. Cylinder Head Fundamentals ..... 6 Hours

Outcome: ***Describe the function and design features of cylinder heads and valve train components.***

1. Explain the function, construction and design features of cylinder heads.
2. Describe the construction and design features of engine valves and related components.
3. Describe the construction and design features of valve train components.
4. Identify cylinder head sealing and retention devices.

M. Cylinder Head Service ..... 8 Hours

Outcome: ***Service cylinder head and valve train components.***

1. Explain cylinder head removal and disassembly.
2. Clean and inspect cylinder heads.
3. Explain cylinder head and valve reconditioning procedures.
4. Inspect valve train components.
5. Explain cylinder head assembly and installation.

SECTION TWO ..... LUBRICATION AND CRANKCASE VENTILATION ..... 14 HOURS

A. Engine Lubrication ..... 8 Hours

Outcome: ***Describe the use and impact of lubricants in natural gas engines.***

1. State the functions and characteristics of natural gas engine oil, including ash content.
2. Explain lubrication theory.
3. Explain the operating principles of a typical lubrication system and related components, including pre and post lube.
4. State the purpose of crankcase ventilation systems.
5. Perform lubrication system inspection and service.
6. Diagnose and repair faults related to lubrication systems and components.
7. Describe fresh oil storage and systems.

B. Oil Analysis Interpretation and Diagnosis ..... 4 Hours

Outcome: ***Describe the use of oil analysis as a diagnostic tool.***

1. Describe oil analysis related to oil condition.
2. Describe oil analysis related to component condition.
3. Describe oil analysis related to engine performance.
4. Explain oil analysis test methods and results.

C. Crankcase Fume Control and Extraction ..... 2 Hours

Outcome: ***Describe the methods and theory of crank case ventilation.***

1. Describe types of crankcase fume control and extraction.
2. Identify the risks and benefits of each type.
3. Describe the operation theory and method for each type.

SECTION THREE..... AIR INDUCTION AND EXHAUST SYSTEMS ..... 3 HOURS

A. Air Induction and Exhaust Systems ..... 3 Hours

Outcome: ***Service air induction systems, exhaust systems and related components.***

1. State the functions of an air induction system.
2. Identify and state the function of air induction system components.
3. State the function of an exhaust system.
4. Identify and explain the operation of exhaust system components.
5. Explain the service procedures for an air induction and exhaust systems.
6. Explain the use of test equipment to measure air inlet restriction and exhaust.
7. Design and service flex joints, insulation and support structures.

SECTION FOUR ..... IGNITION SYSTEMS ..... 20 HOURS

A. Ignition System Fundamentals ..... 4 Hours

Outcome: ***Describe the operating principles and explain the operation of an ignition system and its related components.***

1. Explain the purpose, construction and operation of an ignition system and its related components.
2. State how ionization and induction apply to ignition systems.
3. Describe the operation of distributor ignition systems.

B. Magneto Ignition Systems ..... 4 Hours

Outcome: ***Describe the operation of magneto ignition systems.***

1. Explain the operation of a magneto ignition system.
2. Describe the major components and function of a magneto ignition system.

C. Digital Ignition Systems ..... 4 Hours

Outcome: ***Describe the components and operation of digital ignition systems.***

1. Explain the components and operation of digital ignition systems.

D. Ignition System Diagnosis and Service ..... 8 Hours

Outcome: ***Test, diagnose and adjust ignition systems and their components.***

1. Test and diagnose problems related to ignition systems and their associated components using common electrical and electronic test equipment.
2. Remove, repair and reinstall components.
3. Perform ignition timing adjustment.
4. Identify precautions when working with spark ignition systems.
5. Perform primary, secondary and sensor oscilloscope pattern interpretation.

SECTION FIVE ..... GOVERNOR SYSTEMS ..... 10 HOURS

A. Governors ..... 10 Hours

Outcome: ***Describe the operating principles and maintenance procedures for the various types of governors used on stationary engines and gas turbines.***

1. Describe the application of governors with regards to stationary engines and gas turbines.
2. Describe the operating principles of mechanical and digital governors.
3. Describe governor linkage systems, geometry and adjustment theory.
4. Describe diagnosis, maintenance and safety procedures for stationary engines and turbines.
5. Describe the operating principles and adjusting procedures for over-speed trip mechanisms.

SECTION SIX ..... COMBUSTION THEORY ..... 12 HOURS

A. Fuel Properties ..... 4 Hours

Outcome: ***Explain the composition and physical properties of gaseous and gas from liquid fuels.***

1. Describe the composition and physical properties of gaseous and gas from liquid fuels.
2. Explain the relationship between gaseous fuel composition and energy value.
3. Calculate energy values based on gas composition analysis.
4. Describe the effects of various fuel components on engine systems.

B. Combustion Process ..... 8 Hours

Outcome: ***Explain combustion process types.***

1. Describe the combustion process.
2. Explain the application of a lambda graph.
3. Describe rich burn combustion theory and design.
4. Describe lean burn combustion theory and design.
5. Identify common causes of inefficient or incomplete combustion.

SECTION SEVEN ..... AIR/FUEL SYSTEMS ..... 12 HOURS

A. Air/Fuel System Components and Service ..... 10 Hours

Outcome: ***Describe the design, operation and service of fuel systems.***

1. Explain the design, operation and service of gas regulators.
2. Explain the design, operation and service of carburetion systems.
3. Explain the design, operation and service of fuel injection systems.
4. Explain the design, operation and service of turbo charging systems.
5. Explain the design, operation and service of dual fuel systems.

B. LPG Fuel Systems ..... 2 Hours

Outcome: ***Describe the design, operation and service of LPG fuel systems.***

1. Describe the safety procedures when handling and storing gaseous fuels.
2. Explain the design, operation and service of LPG fuel systems.

SECTION EIGHT..... ENGINE PERFORMANCE AND ADJUSTMENTS ..... 18 HOURS

A. Performance Analysis ..... 18 Hours

Outcome: ***Diagnose engine performance using analysis tools.***

1. Define typical engine performance expectations and norms.
   a) specifications
   b) calculations
   c) load assessment
   d) operational requirements
2. Determine how engine performance is affected by the following factors:
   a) fuel quality
   b) mechanical condition
   c) ignition timing
   d) air/fuel ratio control
   e) site conditions (temperature, elevation, etc.,)
   f) load demand, expectations
   g) history
3. Use analysis tools to measure the following engine and environmental conditions:
   a) voltage, amperage and resistance
   b) exhaust gas composition
   c) ignition timing
   d) pressures
   e) temperatures
   f) vibration and acceleration
   g) dynamic firing pressure
   h) speed
   i) microprocessor input/output
4. Interpret results, make engine adjustments and evaluate results.

SECTION NINE ..... ENGINE STARTING SYSTEMS ..... 21 HOURS

A. Engine Starting Systems ..... 3 Hours

Outcome: ***Explain the design, operation and service of engine starting systems.***

1. Describe types of engine starting systems.

B. Cranking System Fundamentals and Motor Drives ..... 6 Hours

Outcome: ***Explain the design, operation and service of electric starter systems.***

1. Identify components of a typical electric starter.
2. Describe the principles of operation of an electric starter.
3. Identify hazardous environment application of electric starters.
4. Trace an electric starter system circuit diagram.
5. Explain the operation of an electric starter solenoid switch.
6. Identify possible cranking system failures from specific symptoms.

C. Pneumatic Starting Systems ..... 12 Hours

Outcome: ***Explain the design, operation and service of pneumatic starting systems.***

1. Identify components of a typical pneumatic starter system.
2. Describe the principles of operation of a pneumatic starter system
3. Identify hazardous environment application of pneumatic starters.
4. Trace a pneumatic starter system flow diagram.
5. Explain the operation of a pneumatic starter valves, relays and lubricators.
6. Identify possible cranking system failures from specific symptoms.
7. Repair and service a pneumatic starter system.

SECTION TEN ..... ENGINE COOLING SYTEMS ..... 12 HOURS

A. Engine Cooling System ..... 12 Hours

Outcome: ***Explain the design, operation and service of engine cooling systems.***

1. Describe the principles of engine cooling systems.
2. Explain the operation of a typical engine cooling system and its components.
3. Perform engine liquid cooling system troubleshooting, repair and maintenance.
4. Describe air, ebullient and evaporation cooling systems.
5. Describe types of coolant composition and selection.
6. Explain coolant analysis and interpret results.

SECTION ELEVEN ..... BASIC DIESEL ..... 6 HOURS

A. Diesel Fuel Systems and Engine Control Adjustments ..... 6 Hours

Outcome: ***Explain the fundamental design and operation of diesel engine.***

1. Describe the fundamental design and operation of a diesel engine.
2. Identify the layout and components of a basic fuel injection system.

3. Explain the function of the components required in the basic diesel fuel injection system.
4. Describe fuel characteristics, storage and maintenance.
5. Describe the design, operation and maintenance of a positive air shut off system.
6. Describe the design and operation of a bi-fuel (diesel/natural gas) fueled engine.

THIRD PERIOD TECHNICAL TRAINING
NATURAL GAS COMPRESSION TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE ..... ROTARY COMPRESSORS ..... 48 HOURS

A. Screw Compressors ..... 24 Hours

Outcome: ***Explain the design, operation and service of screw compressors.***

1. Describe design, operation and service of screw compressors.
2. Describe screw compressor sizing and selection for efficiency.
3. Demonstrate use of OEM screw compressor application and sizing software.
4. Describe screw compressor components.
5. Describe the systems of a screw compressor package.
6. Explain the basic operation of common screw compressor capacity control systems.
7. Explain lubricant selection.
8. Perform maintenance, troubleshooting and overhaul of screw compressors and systems.

B. Vane Compressors ..... 12 Hours

Outcome: ***Explain the design, operation and service of vane compressors.***

1. Describe the design, operation and service vane compressors.
2. Describe vane compressor components and systems.
3. Perform maintenance, troubleshooting and overhaul of vane compressors.

C. Scroll Compressors ..... 3 Hours

Outcome: ***Explain the design, operation and service of scroll compressors.***

1. Describe the design, operation and service scroll compressors.
2. Describe scroll compressor components and systems.
3. Perform maintenance, troubleshooting and overhaul of scroll compressors.

D. Dynamic Compressors ..... 6 Hours

Outcome: ***Explain the design, operation and service of centrifugal flow compressors and axial flow compressors.***

1. Describe the design, operation and service centrifugal and axial flow compressors.
2. Describe centrifugal and axial flow compressor components and systems.
3. Perform maintenance, troubleshooting and overhaul of centrifugal and axial flow compressors.

E. Lobe Blower ..... 3 Hours

Outcome: Explain the design, operation and service of lobe blowers.

1. Describe the design, operation and service lobe blowers.
2. Describe lobe blower components and systems.
3. Perform maintenance, troubleshooting and overhaul of lobe blower.

SECTION TWO ..... PUMPS ..... 30 HOURS

A. Pump Selection ..... 6 Hours

Outcome: Explain the working principles and selection procedures for dynamic pumps.

1. Explain dynamic pump principles.
2. Explain the procedure for selecting dynamic pumps.

B. Dynamic Pumps ..... 6 Hours

Outcome: Explain the construction of dynamic pumps.

1. Describe pump impeller styles.
2. Describe types and applications of dynamic pumps.
3. Describe pump and system components.
4. Describe sealing devices.

C. Positive Displacement Pumps ..... 6 Hours

Outcome: Explain the construction, selection and operation of positive displacement pumps.

1. Explain positive displacements pump principles.
2. Describe types and applications of reciprocating pumps.
3. Describe types and applications of rotary positive displacement pumps.
4. Describe pump and system components.

D. Pump Operation and Repair ..... 12 Hours

Outcome: Perform pump troubleshooting, maintenance and repair procedures.

1. List conditions that affect pump operations.
2. Describe and perform installation and removal of mechanical seals.
3. Perform pump troubleshooting, maintenance and repair procedures.

SECTION THREE ..... AC MOTORS AND DRIVES ..... 4 HOURS

A. AC Motors ..... 2 Hours

Outcome: Describe the design, operation and service of AC motors.

1. Describe the types and the construction of AC motors.
2. Explain and demonstrate safety lockout/tagout procedures.
3. Describe unique hazards and procedures associated with low and medium voltage installations.
4. Explain electric motor maintenance.

B. Starters and Drives ..... 2 Hours

Outcome: ***Describe the types and application of starters and drives.***

1. Describe types and application of starters.
2. Describe types and application of drives.

SECTION FOUR ..... POWER GENERATION ..... 26 HOURS

A. AC Power Generation ..... 26 Hours

Outcome: ***Describe AC Power Generation application, diagnostics and control.***

1. Identify safety and limitations associated with AC power generation equipment.
2. Describe typical AC generator types and components.
3. Describe applications and sizing of AC power generation.
4. Describe the relationship and adjustment of governors and AVRs.
5. Describe generator switching devices.
6. Describe AC power generator control systems.
7. Describe synchronization of generators and paralleling systems.
8. Explain and perform troubleshooting procedures for prime mover and control systems for an AC Power Generation system.

SECTION FIVE ..... POWER TRANSMISSION ..... 64 HOURS

A. Transmission of Force and Motion ..... 4 Hours

Outcome: ***Use formulas to solve trade-related problems involving the principles of the transmission of force and motion.***

1. Identify key terms and concepts for working with formulas to calculate the mechanical advantage of simple machines.
2. Solve trade-related problems involving torque.
3. Solve trade-related problems involving pulleys and gears.

B. Bearings and Seals ..... 16 Hours

Outcome: ***Describe the design, operation and service of common bearings and seals.***

1. Identify types of anti-friction bearings.
2. Identify types of friction bearings.
3. State bearing functions and applications.
4. State seal functions and applications.
5. Diagnose common bearing and seal faults.
6. Perform bearing and seal service.

C. Couplings ..... 12 Hours

Outcome: ***Describe the design, operation and service of couplings.***

1. Describe types and characteristics of rigid couplings.
2. Describe types and characteristics of flexible couplings.

3. Describe types and characteristics of special purpose couplings.
4. Describe various coupling applications.
5. Describe and perform coupling removal and installation procedures.

D. Belts ..... 6 Hours

Outcome: ***Describe the design, operation and service of belt power transmission systems.***

1. Describe the types, construction and applications of V-belts.
2. Describe and perform V-belt installation, alignment and maintenance procedures.
3. Describe the types, construction, application and maintenance of sheaves and pulleys.
4. Describe the types, construction, application and maintenance of link belts.

E. Gearing Fundamentals ..... 12 Hours

Outcome: ***Explain the fundamental terminology and characteristics of gears.***

1. Explain gear terminology.
2. Describe the characteristics of various types of gears.
3. Describe the characteristics of various gear systems.
4. Describe and perform maintenance and overhaul of gear sets.

F. Shaft Drives ..... 2 Hours

Outcome: ***Describe the design, operation and service of shaft drives.***

1. Describe types and construction of shaft drives.
2. Describe types, application and maintenance of universal joint.
3. Describe and perform drive shaft alignment.

G. Chain Drives ..... 3 Hours

Outcome: ***Describe the design, operation and service of chain drive power transmission systems.***

1. Describe the types, construction and applications of chain drives.
2. Describe and perform chain drive installation, alignment and maintenance procedures.

H. Hydraulic Drives ..... 3 Hours

Outcome: ***Describe the design, operation and maintenance of hydraulic drives.***

1. Describe the types, construction and applications of hydraulic drives.
2. Describe and perform hydraulic drive troubleshooting, maintenance and repair.

I. Clutch Fundamentals and Service ..... 6 Hours

Outcome: ***Describe the design, operation and service of common clutch types.***

1. Describe the operation and maintenance of over-centre clutches.
2. Describe and perform over-centre clutch troubleshooting, maintenance and repair.

SECTION SIX ..... EQUIPMENT ALIGNMENT ..... 22 HOURS

A. Cross Dial Alignment ..... 12 Hours

Outcome: ***Align two machines using the cross dial and graphical method.***

1. Describe graphical alignment method.
2. Determine the alignment corrections required to align two machine shafts in horizontal and vertical planes, using the cross dial method.

B. Laser Shift Alignment ..... 6 Hours

Outcome: ***Use formulas to solve trade-related problems involving the principles of the transmission of force and motion.***

1. Explain the basic principles of laser equipment used for shaft alignment.
2. Describe and perform shaft alignment using laser systems.

C. Machine Levelling ..... 4 Hours

Outcome: ***Describe how to install machinery at the correct location and elevation using laser equipment.***

1. Review safety, grouting and levelling.
2. Describe types of laser levelling equipment.
3. Describe laser levelling applications and procedures.
4. Describe and perform auxiliary machine connection; flex, stress.
5. Describe and perform machine hold down; soft foot, wedge foot, pipe strain.

SECTION SEVEN ..... VIBRATION ..... 30 HOURS

A. Vibration Analysis ..... 14 Hours

Outcome: ***Explain the methods used to detect the causes of vibration.***

1. Explain vibration using the associated terminology.
2. Describe methods of measuring vibration.
3. Describe how strobe lights are used to measure phase angles and check shaft rpm.
4. Describe machine signature and its importance in vibration analysis.
5. Explain the causes of vibration in rotating equipment.
6. Explain basic vibration analysis.
7. Explain the use of vibration analysis as a part of a predictive maintenance program.
8. Describe solutions to vibration problems.

B. Vibration Measurement ..... 12 Hours

Outcome: ***Describe and explain principles of vibration measurement.***

1. List sources of vibration.
2. List and describe vibration transducers.
3. Describe the relationships between vibration and frequency including mechanical and acoustic resonance and critical speed.
4. Demonstrate mechanical and acoustic resonance as it applies to vibration analysis.

C. Balancing.....4 Hours

Outcome: ***Explain balancing methods.***

1. Describe causes of imbalance.
2. Describe the types of imbalance.
3. Define imbalance and balancing.
4. Explain imbalance correction methods and considerations.

SECTION EIGHT..... PREDICTIVE AND FAILURE ANALYSIS ..... 16 HOURS

A. Non-Destructive Testing .....6 Hours

Outcome: ***Explain non-destructive testing.***

1. Explain dye penetrate testing.
2. Explain magnetic particle testing.
3. Explain radiographic testing.
4. Explain ultrasonic testing.
5. Explain eddy current testing.
6. Describe types and classifications of metals including tensile and hardness testing.

B. Failure Analysis .....10 Hours

Outcome: ***Explain purpose and procedures for undertaking failure analysis.***

1. Describe purpose and procedural method to undertake failure analysis.
2. Identify the importance of proper documentation to support failure analysis.
3. Explain importance of recommendation for remedial action.

FOURTH PERIOD TECHNICAL TRAINING
NATURAL GAS COMPRESSION TECHNICIAN TRADE
COURSE OUTLINE

UPON SUCCESSFUL COMPLETION OF THIS PROGRAM THE APPRENTICE SHOULD BE ABLE TO PERFORM THE FOLLOWING OUTCOMES AND OBJECTIVES.

SECTION ONE ..... HEAT EXCHANGERS ..... 18 HOURS

A. Heat Exchangers ..... 8 Hours

Outcome: ***Describe the design, operation and service of heat exchangers.***

1. Describe principles of heat exchange.
2. Describe types and construction of heat exchangers.
3. Explain troubleshooting, maintenance and repair of heat exchangers.
4. Explain application of cooler data sheets in sizing and specification of heat exchangers.

B. Fans ..... 8 Hours

Outcome: ***Explain the design, operation and service of fan components and accessories.***

1. Describe types and operating principles of fans.
2. Describe fan components and accessories.
3. Describe maintenance, troubleshooting and overhaul of fans.

C. Sound ..... 2 Hours

Outcome: ***Describe objectionable sound sources and mitigation practices.***

1. Identify sources and types of objectionable sound.
2. Describe and demonstrate sound measurement.
3. Describe typical sound attenuation equipment.
4. Describe occupational exposure limits.
5. Describe environmental regulatory limits.

SECTION TWO ..... PROCESS EQUIPMENT I ..... 85 HOURS

A. Gas Compression ..... 26 Hours

Outcome: ***Describe gas compression application.***

1. Describe selection, sizing and configuration of compression equipment based on application.
2. Demonstrate compressor performance software.
3. Demonstrate knowledge of ideal gas laws to manual calculate compressor performance.
4. Describe and demonstrate troubleshooting procedures related to performance.

B. Separation and Filtration ..... 4 Hours

Outcome: ***Describe the basic principles and equipment used for particulate filtration and liquid separation.***

1. Describe the principles and operation of two and three phase separators.

2. Describe the principles and operation of particulate filtration.
3. Describe the principles and operation of coalescing vessel.

C. Gas and Air Dryers ..... 16 Hours

Outcome: Describe the design, operation and service of air and gas dryers.

1. Describe types, construction and operation of air and gas dryers.
2. Perform service, troubleshooting and maintenance of air and gas dryers.

D. Process Dehydration ..... 5 Hours

Outcome: Describe the types, components and principles of process dehydration.

1. Describe the types, components and operating principles of process dehydration.

E. Fractionation ..... 3 Hours

Outcome: Describe the types, components and principles of fractionation.

1. Describe the types, components and operating principles of the fractionation process.

F. Boilers and Direct Fired Heaters ..... 2 Hours

Outcome: Describe the types, components and principles of boilers and fired heaters.

1. Describe the types, components and operating principles of boilers and direct fired heaters.

G. Fire and Gas Detection ..... 6 Hours

Outcome: Describe the fire and gas detection systems.

1. Identify fire and gas detection equipment.
2. Describe fire and gas detection components and systems.
3. Describe safe work practice considerations.

H. Emergency Shutdown Systems ..... 3 Hours

Outcome: Describe Emergency Shutdown Systems (ESD).

1. Describe the purpose of an ESD System.
2. Describe the operation and components of an ESD System.

I. Pressure Safety Relieving Devices ..... 4 Hours

Outcome: Describe pressure safety relieving devices.

1. Explain the purpose of relieving devices.
2. Describe the operation and components of common pressure relieving devices.

J. Pressure Regulators ..... 16 Hours

Outcome: Describe the design, application and service of pressure regulators.

1. Describe the operating principles and applications of regulators.
2. Describe and illustrate the design and differences between types of pressure regulators.
3. Demonstrate the installation and maintenance of a pressure regulator.
4. Perform overhaul and adjustment of pressure regulators.

SECTION THREE ..... PROCESS EQUIPMENT II ..... 54 HOURS

A. Pneumatic Systems ..... 6 Hours

Outcome: ***Describe the design, application and service of pneumatic systems.***

1. Describe the design, application and service of pneumatic components and pneumatic systems.
2. Describe the benefits and disadvantages of pneumatic systems compared to other energy systems.

B. Natural Gas Process Refrigeration ..... 12 Hours

Outcome: ***Describe the operational principles and maintenance related to natural gas process refrigeration systems.***

1. List and explain the basic principles that apply to natural gas process refrigeration.
2. List and explain the various components, refrigerants, oils and accessories of natural gas process refrigeration.
3. Describe control of natural gas process refrigeration systems.
4. Describe and perform common service and equipment maintenance.

C. Gas Turbines ..... 6 Hours

Outcome: ***Describe the design, operation and service for gas turbines.***

1. Describe the applications, advantages and disadvantages of gas turbines.
2. Describe the working principles of gas turbines.
3. Describe the function of gas turbine systems and components.
4. Describe inspection, servicing and maintenance procedures for gas turbines.

D. Natural Gas Facility Control Philosophy ..... 30 Hours

Outcome: ***Describe and explain Natural Gas Facility Control Philosophy.***

1. Explain and use of P&ID, PFD (Process Flow Diagram) and BOM (Bill of Materials) to identify equipment and process flow.
2. Identify and explain compression side stream, split stream, bypass, blow down, capacity control and relationship to plant operations
3. Identify and explain facility range of operational parameters.
4. Identify and explain operation of station valving and flow.
5. Use performance software to determine inter-stage and interline flows, pressures and temperatures of a simple multi-compressor facility.

SECTION FOUR ..... PNEUMATIC CONTROLS ..... 31 HOURS

A. Pressure Measurement ..... 10 Hours

Outcome: ***Apply the principles of pressure and the standards used to measure pressure.***

1. Describe pressure, pressure units, and pressure standards.
2. Apply the principles of pressure standards to pressure measurement techniques.
3. Describe pressure scales and reference points.
4. Perform pressure calculations.

B. Link and Lever Systems ..... 6 Hours

Outcome: ***Describe the design, operation and service of Link & Lever systems.***

1. Define the terms span, angularity, zero, hysteresis, and deadband as they relate to mechanical systems.
2. Describe the force balance measurement method.
3. Perform calibrations of Link and Lever systems.

C. Pneumatic Components and Feedback Systems ..... 15 Hours

Outcome: ***Select, install, and maintain pneumatic components and feedback systems.***

1. Describe the operation and construction of pneumatic automatic controls, pilots, flapper nozzles, end devices and pneumatic relays.
2. Describe the applications for pneumatic relays.
3. Describe alternate gas supplies used in pneumatic systems and related hazards.
4. Demonstrate the calibration of a feedback system.
5. Perform pneumatic control panel troubleshooting.

SECTION FIVE..... ELECTRONIC CONTROL – PROGRAM LOGIC CONTROL ..... 26 HOURS

A. Controls: Schematics, Ladder Diagrams and Logic Control ..... 20 Hours

Outcome: ***Describe and demonstrate PLC programming and configuration.***

1. Interpret ladder diagrams and PLC programs.
2. Explain basic electronic control systems, including end devices.
3. Describe and demonstrate logic control programming.
4. Demonstrate configuration of programmed logic control systems.
5. Test, calibrate and adjust system components.

B. Protocols ..... 6 Hours

Outcome: ***Describe protocols of communication systems.***

1. Describe and compare the capabilities of digital field devices to that of analog devices.
2. Describe common communication faults and troubleshooting techniques.
3. Describe data interface protocols.

SECTION SIX..... MANAGED MAINTENANCE ..... 20 HOURS

A. Maintenance Planning..... 12 Hours

Outcome: ***Describe maintenance management procedures for equipment/facility performance and safety.***

1. Define maintenance management.
2. Describe and compare maintenance management strategies.
3. Identify primary factors in maintenance planning.
4. Define maintenance planning and scheduling functions.
5. Develop life cycle maintenance strategy for equipment.

B. Project Management ..... 8 Hours

Outcome: ***Describe and apply project management principles.***

1. Describe project management principles.
2. Describe estimating procedures.
3. Describe supply chain.
4. Describe risk management.
5. Develop project schedule

SECTION SEVEN ..... NEW AND EMERGING TECHNOLOGIES ..... 6 HOURS

A. Workplace Coaching Skills ..... 2 Hours

Outcome: ***Describe and demonstrate the coaching skills used for training apprentices.***

1. Describe and demonstrate the coaching skills used for training apprentices.

B. New and Emerging Technologies ..... 2 Hours

Outcome: ***Describe new and emerging technologies associated with the Natural Gas Compression Technician trade.***

1. Describe new and emerging technologies associated with the Natural Gas Compression Technician trade.

C. Apprenticeship and Industry Training Board – Industry Network ..... 2 Hours

Outcome: ***Describe the role of the Apprenticeship and Industry Training Board and the network of industry committees that represent the trades and occupations in Alberta.***

1. Describe the roles and responsibilities of the Alberta Apprenticeship and Industry Training Board, government and post secondary institutions.
2. Describe the roles and responsibilities of the PAC, LAC and occupational committees.

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